important, of course, for teams that have been inserted hundreds of miles away. For short-range missions, a driver can carry a standard FM radio on his back. Our scout teams also train with AM radios, which give them increased range. The teams need a basic understanding of building field expedient antennas and tuning AM radios. These radios allow our battalion headquarters in Anchorage to speak to a company 350 miles away in Fairbanks.

One technique for maintaining contact with the teams is to have scheduled report times several times a day and to require continuous radio communication only when enemy contact is expected. Satellite communication is another option. We have conducted reconnaissance and counterreconnaissance operations for eight continuous days with teams as far away as Nome speaking to our main command post in Anchorage. *(For detailed discussions of the challenges of operating in cold environments, see the two-part "Cold Regions: Environmental Influences on Military Operations," by Brigadier General Peter W. Clegg and Colonel Robert H. Clegg, INFANTRY, July-August and September-October 1992.)*

The tactical use of snowmachines in northern operations allows a commander great flexibility. He can insert any number of teams on a wide variety of combat or combat support missions. He can keep reconnaissance elements on the ground and communicate with them over hundreds of miles. The reconnaissance and security they provide can be invaluable.

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Ultralight Aircraft
A New Tool for Airmobility

MAJOR JAMES P. STANTON

In 1784, Benjamin Franklin, then U.S. Ambassador to France, witnessed the fascinating aerial spectacle of men riding in air balloons. Thrilled and far-sighted, he asked: *Where is the prince who can afford so to cover his country with troops for its defense. . .that 10,000 men, descending from the clouds, might not. . . do an infinite amount of mischief before a force could be brought to repel them?* Thus, Franklin astutely envisioned the potential for airmobility.

This concept was developed in the waning days of World War I, exercised with gliders and paratroops in World War II, and refined during modern wars of insurgency with the effective employment of the helicopter. In our highly technological world of today, we now have the deceptively simple, seemingly anachronistic, and ultimately appropriate aircraft for airmobility—ultralight air machines made of aluminum and Dacron.

I believe that the U.S. Army's continuing requirement for airmobile troop insertion on the battlefield is the most significant role for properly configured ultralight aircraft.

Although the helicopter has proved effective in battle, its use for infantry mobility is not without limitations. In Vietnam, for example, the relative vulnerability of the helicopter's airframe required complete air superiority in an operating area. Few landing zones were available, and suppressing enemy activity near those zones seriously drained a unit's resources. As current doctrine emphasizes, the use of helicopters for airmobile insertions is never routine—conditions must be right and commanders must be responsible for "meticulous planning" to hit "exposed or assailable flanks" by using "concealed routes." In addition, helicopters are extremely costly to purchase, operate, and maintain; their crews require extensive training; and their cargos of men and equipment are priceless.

Ultralight aircraft could effectively transport infantrymen to the modern battlefield while avoiding some of these limitations. They could perform admirably at an extremely low cost while providing for combat survivability. The ultralight certainly has a place above the modern battlefield, and its capabilities fit the requirements of infantry movement.

The development of lightweight, flexible airfoils in the 1950s gave rise to the popular sport of hang-gliding in the 1970s. The airframes that were developed were safe and efficient. Then, innovative hang-glider enthusiasts—tired of waiting for the perfect wind—began to experiment with propulsion using chain-saw motors, and soon hundreds of ultralight designs were on the international market.

These aircraft have the required performance specifications, could be deployed and employed effectively, and could be designed with the specific military role in mind, including provisions for battlefield survivability and defense. (Both Israel and Saudi Arabia have purchased ultralights for military use, as have some Central American nations.)

Numerous designs are available around the world; the United States alone has about 100 individual designs. Off-the-shelf models have the following typical performance characteristics:

- Speed of 30 to 63 miles per hour.
- Climb rate of 600 to 1,200 feet per minute.
- Takeoff distance of 100 feet.
- Landing speed of 25 miles per hour.
- Ceiling of 10,000 to 21,000 feet.
- Range of 100 to 300 miles.
- Service weight of 250 pounds.
- Payload of 250 pounds.

One successful design offers two engines with excellent performance, and it can be assembled in half an hour.

Ultralight aircraft weigh very little; they are compact and wonderfully air-transportable. They can be unpacked and prepared for flight in minutes, need little space for takeoff, and carry their payload for impressive distances. In addition, they have the benefit of structural strength, which allows for gust encounters, rough handling, and defensive maneuvering against surface-to-air threats.

To add to this system's potential, a battalion equipped with ultralights should have all the capability and support of a normal airmobile battalion, including the full complement of airmobile companies. But when conditions show that the insertion task could be done effectively with ultralights, the unit's helicopter resources could then be reserved for heavier logistic support (transporting light artillery and combat engineers, for example), threat suppression, resupply, and air evacuation if the need arose.

Ultralight-trained soldiers could unpack, service, and employ their own aircraft; there would be no need for a cadre of pilots with expensive training. In fact, experience in sport ultralight flight training shows that airmobile infantry troops could become expert ultralight combat pilots after training measured in days and weeks instead of months and years.

Other characteristics are also encouraging: Because of the short takeoff distances required, large numbers of ultralights could get into the air quickly. They could be flown extremely low—skimming the tree tops, free from enemy observation—and they would be nearly invisible on a radar screen. (If their tubing could be made of carbon or boron fiber, they would hardly show up on radar at all.)

NIGHT OPERATIONS

Night employment would be possible with night vision goggles, and the infantry pilots could maintain formation, even with minimal moonlight. With on-board helmet-mounted radios, the commander could avoid threats and select new landing zones if the tactical situation changed.

The design and weight of the ultralight offer a potential benefit that even a vertical-takeoff-and-landing helicopter could not match. For night operations, or when landing on inhospitable terrain, the ultralight has another fascinating feature: It incorporates an airframe-mounted ballistic parachute recovery system, which is used extensively by sport ultralight enthusiasts today. If an ultralight cannot land in the conventional manner, the pilot stops his engines, deploys his ballistic parachute, and descends safely from altitudes as low as 150 feet above the ground. Infantrymen could arrive on the ground with both their combat gear and their air-machine intact.

The survivability and effectiveness of a military ultralight on the modern battlefield could be further improved. Crew members could be fitted with Kevlar body protection, such as the Army's current personal armor system, ground troops (PASGT), which includes protective vests and helmets. Ballistic fabric shields could protect the pilot's seat and the aircraft's power plant. Simple chaff and flare dispensers could offer further protection. Exhaust noise and infrared mufflers are also plausible. Finally, simple avionics could help with weather penetration and night assault while theater-specific camouflage could be sprayed on during the pre-strike assembly stage.

All told, these modifications could aid in the employment and survivability of ultralights in modern threat environments. Ultralight aircraft have the performance, ease of employment, and survivability to merit serious consideration by Army tacticians for airmobile insertions. This concept offers considerable promise for mission accomplishment and great cost savings.

Off-the-shelf sport ultralights are inexpensive, compared to other aircraft. For $10,000, a buyer could obtain a top-of-the-line ultralight machine. Military modifications would drive this price up, of course; it might even double or triple. But this price would still be low, compared to that of a military helicopter.

A commander might even be able to consider an ultralight disposable. If the threat or the terrain dictated a one-way mission, he could make this decision without a great deal of anxiety, provided the tactical situation allowed the resupply, reinforcement, or evacuation of the inserted troops by the helicopters reserved for these tasks. The commander, by not exposing valuable helicopters and crews to the threats of the initial battlefield assault, would thus preserve these resources while effectively inserting a light, mobile ground force.

In addition, airmobile infantrymen could be trained quickly and inexpensively to fly and use ultralights. The small gasoline engines use little fuel; the airframes are sturdy enough to withstand the punishment of training flights; and few flight hours are required for pilots to attain and retain proficiency. Ultralight flight training for soldiers would require little airspace or runway surface. Planners therefore would not need to worry about providing range space or shutting down conventional airfield traffic during ultralight training periods.

Finally, combat-configured ultralight machines could be pre-packaged for air transport and stored for long periods. Hundreds of ultralights would weigh little and could fit in the cargo hold of any transport aircraft. Considering their effectiveness in performing the air insertion role, ultralights have immense potential for cost saving. Even if deployed in theater, this packaged asset would not actually be used unless the tactical situation called for it.

An Army study of this potential should be conducted with the assistance of logistic planners, ultralight manufacturers, and the producers of associated military hardware and support equipment. Only then could we measure the true cost-saving potential of using ultralights in a tactical scenario.

That the infantry requires mobility is a vital truth of combat today, just as it was in the past. Army doctrine fully embraces this idea and incorporates the technology of the helicopter to do it well. Ultralight aircraft could also meet the need for infantry mobility and could do the job at a much lower cost.

It is time for Army tacticians and analysts to examine these cost savings and to decide on the best employment plans. It is plain to see, however, that these savings could be substantial and that ultralights could be used successfully for the insertion task.

Now is our opportunity to examine and adopt airmobile insertion by ultralight. Ben Franklin would expect no less.

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Direct Effective Fire Line

MAJOR THOMAS J. MANGAN III

As a result of the 1991 Gulf War, the role of air power has gained new followers and has expanded rapidly in operational planning. As the Air Force champions the causes of air interdiction, counter-air operations, and new technology, however, the role of close air support (CAS) is seldom mentioned.

CAS is important to the success of ground campaigns and battles, and it may take on even greater importance after the Army's planned force reductions. In future contingency operations, we may have more Air Force assets than ground forces in place when hostilities begin, because the early-deploying ground forces will need more battlefield air interdiction (BAI) and close air support to hold off the enemy until additional ground combat power can be brought to bear.

With our new technological advances, more accurate and lethal weapons, and better means of target acquisition, the way we see and fight the battle is changing. Support for the maneuver force may no longer only take the form of low and slow CAS aircraft flying overhead. Instead, it may take the form of a combination of battlefield effects close to our own troops. It is in this light that the ground forces need to re-examine the application of CAS. While the principles and techniques of the past are still valid, we can improve the way CAS is planned and executed. One recommendation for integrating CAS into the direct-fire battle is to use what I call the direct effective fire line (DEFL).

The DEFL is a conceptual planning line on the near side of which effective direct and indirect fires are employed against enemy forces. The DEFL is defined by the limit—forward of the forward line of own troops (FLOT)—to which direct fires can effectively destroy the enemy with a high percentage of first engagement kills. Additionally, observed and controlled indirect fires (directed fires) can be rapidly and effectively adjusted between the DEFL and the FLOT where they will contribute significantly to the successful direct-fire battle.

The DEFL concept grew out of my experience at the National Training Center (NTC) and developed further after I discussed the use of CAS with veteran DESERT STORM A-10 pilots, air support operations center officers, air liaison officers, ground liaison officers, and ground battle participants. The DEFL reflects one aspect of the way air power was successfully used in DESERT STORM and the way its employment can be improved in future conflicts.

Too often at the NTC, the appearance